Claims

1. A recording medium storing therein a digital stream that is obtained by multiplexing a graphics stream and a video stream, the graphics stream being a packet sequence that includes a data packet storing graphics data and a control packet storing control information, wherein

the data packet has a time stamp whose value indicates a decoding time of the graphics data, and

the control packet has a time stamp whose value indicates a time at which the graphics data, after being decoded, is displayed combined with the video stream.

2. The recording medium of Claim 1, wherein

the control information includes type information that indicates a memory management start,

the time stamp of the control packet is a presentation time stamp, and

the control packet further includes a decode time stamp whose value indicates a point of a reproduction timeline of the digital stream, which corresponds to the memory management start, and a time at which the control information is read to a memory.

3. The recording medium of Claim 2, wherein

the value of the presentation time stamp is obtained

by adding a predetermined value to the value of the decode

time stamp, where the predetermined value is based on: a longer

one of a period required for clearing of a screen, and a period

5   required for decoding of the graphics data; and a period

required for writing of the graphics data to the screen.

4. The recording medium of Claim 1, wherein

the control information is one of: information

10   indicating a difference with preceding control information;

a duplicate of the preceding control information; and

information indicating that memory management continues from

another digital stream,

the time stamp of the control packet is a presentation

15   time stamp, and

the control packet further includes a decode time stamp

whose value indicates a time at which the control information

is read to a memory of a reproduction apparatus.

20   5. The recording medium of Claim 4, wherein

the value of the presentation time stamp is obtained

by adding a predetermined value to the value of the decode

time stamp, where the predetermined value is based on: a longer

one of a period required for clearing of a screen and a period

25   required for decoding of the graphics data; and a period

required for writing of the graphics data to the screen.

6. The recording medium of Claim 5, wherein

the screen clearing is clearing of a window area of

5   the graphics plane, the graphics plane being at which the

graphics data is to be disposed,

the graphics stream includes a window define packet

storing window information, and

the window information indicates the window area of

10   the graphics plane.

7. The recording medium of Claim 6, wherein

a value of a decode time stamp of the window define

packet indicates a time in a range between a time shown by

15   the decode time stamp of the control packet and a time shown

by the time stamp of the data packet, inclusive, and

a value of a presentation time stamp of the window define

packet indicates a time recommended to start transferring

the graphics data for display.

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8. The recording medium of Claim 7, wherein

the graphics stream includes a palette define packet

storing palette information that defines color setting used

in display of the graphics data, and

25   a value of a presentation time stamp of the palette define

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packet indicates a time when the palette information becomes

available for use.

9. The recording medium of Claim 1, wherein

5   the graphics stream has two sets of graphics data, and

a value of the time stamp of the control packet is obtained

by adding a predetermined value to a value of the time stamp

of the data packet, where the predetermined value is a total

of a period x and a period y,

10   the period x being a longer one of: a total of

a period required for clearing a screen and a period

required for writing the former of the two sets of graphics

data after decoded, to the screen; and a total period

required for decoding the two sets of graphics data, and

15   the period y being a period required for writing,

to a screen, the latter of the two sets of graphics data

after decoded.

10. The recording medium of Claim 1, wherein

20   the graphics stream includes a plurality of data packets

storing graphics data, including the data packet,

the data packets make up a data-packet sequence,

the data-packet sequence constitutes graphical button

materials,

25   the time indicated by the time stamp of the control packet

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is an initial display time of an interactive screen, and

. a time at which the initial display is performed is

obtained by adding a predetermined period to a decoding ending

time of graphics data positioned at a middle of the data-packet

5   sequence,

where the predetermined period is based on a total of

a first period required for clearing a graphics plane of a

reproduction apparatus and a second period required to perform

writing for the initial display, to the graphics plane.

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11. The recording medium of Claim 10, wherein

if button materials, which are to be in a selected state

as a default in the initial display, are statically determined,

the control information includes default selected

15   information specifying the button materials, and the second

period is a period required for writing, to the graphics plane,

a .total of: firstly displayed part of decompressed graphics

data representing a selected state of one button; and firstly

displayed part of decompressed graphics data representing

20   normal states of buttons different from the button.

12. The recording medium of Claim 10, wherein

if button materials, which are to be in a selected state

as a .default in the initial display, dynamically change,

25   the second period is a period required for writing data

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of size T, to the graphics plane,

where the size T is obtained by adding together sizes x of all buttons, a size x being obtained by an expression of:

5   size x = max(N-first,S-first),

N-first representing firstly displayed part of entire graphics data representing a normal state,

S-first representing firstly displayed part of entire graphics data representing a selected state, and

10   max(a,b) being a formula for indicating one of "a" and "b" that has a larger size therebetween.

13. The recording medium of Claim 10, wherein the control information includes type information, and

15   when corresponding type information indicates a memory management start, the predetermined period is a total of the first period and the second period, and

when the type information indicates either a difference with preceding control information, or a

20   duplicate of the preceding control information, the predetermined period is the second period.

14. The recording medium of Claim 10, wherein the graphics stream includes a palette define packet

25 storing palette information that defines color setting used

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in display of the graphics data in the plurality of data packets,

and

a value of a presentation time stamp of the palette define

packet indicates a time when the palette information becomes

5   available for use.

15. A reproduction apparatus for a digital stream that

is obtained by multiplexing a video stream and a graphics

stream, the graphics stream being a packet sequence that

10   includes a data packet storing graphics data and a control

packet storing control information, the reproduction

apparatus comprising:

a video decoder operable to obtain a moving picture by

decoding the video stream; and

15   a graphics decoder including:

a processor that starts decoding of graphics data when

a current reproduction point of the video stream reaches

a point shown by a decode time stamp of the data packet,

and ends the decoding when the current reproduction point

20   reaches a point shown by a presentation time stamp of the

data packet; and

a controller that, according to a presentation time

stamp of the control packet, combines, with a video stream,

the graphics data after the decoding, and displays the

25   graphics data combined with the video stream.

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16. The reproduction apparatus of Claim 15, wherein the graphics decoder includes:

a coded data buffer for storing compressed graphics data, and

an object buffer for storing decompressed graphics data resulting from the decoding of the processor, and the reproduction apparatus includes a graphics plane for storing part of the decompressed graphics data obtained by the decoding of the processor, the part of the decompressed graphics data being used for display,

the controller judges whether type information included in the control information indicates a memory management start, and if judging affirmatively, clears the coded data buffer, the object buffer, and the graphics plane when the current reproduction point of the video stream reaches a point shown by a decode time stamp of the control packet.

17. The reproduction apparatus of Claim 16, wherein the controller, when the current reproduction point reaches a point shown by the decode time stamp of the control packet, starts clearing the graphics plane, and

the processor, when the current reproduction point reaches a point shown by the decode time stamp of the data packet, decodes the graphics data in parallel with the clearing

of the controller, and

the controller, when the current reproduction point reaches a point shown by the presentation time stamp of the control packet, writes the decompressed graphics data, to the graphics plane.

18. The reproduction apparatus of Claim 17, wherein the value of the presentation time stamp of the control packet is obtained by adding a predetermined value to a value of the decode time stamp of the control packet, where the predetermined value is based on: a longer one of a period required for clearing of a screen, and a period required for decoding of the graphics data; and a period required for writing of the graphics data to the screen, and

the controller, when the current reproduction point reaches a point shown by the presentation time stamp of the control packet, displays content of the graphics plane.

19. The reproduction apparatus of Claim 16, wherein the graphics stream includes a window define packet storing window information,

the controller clears the graphics plane when the type information indicates a memory management start, and clears a window area of the graphics plane, which is indicated by the window information, when the type information indicates

other than a memory management start.

20. The reproduction apparatus of Claim 19, wherein

control information, whose type information does not

5   indicate a memory management start, is one of: information

indicating a difference with preceding control information;

a duplicate of the preceding control information; and

information indicating that memory management continues from

another digital stream, and

10   when the current reproduction point reaches a point shown

by a decode time stamp of a control packet including said

control information whose type information does not indicate

a memory management start, the controller reads corresponding

control information to a memory of the reproduction apparatus.

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21. The reproduction apparatus of Claim 19, wherein

a decode time stamp of the window define packet indicates

a time in a range between a time shown by a decode time stamp

of the control packet and a time shown by a decode time stamp

20   of the data packet, inclusive, and

decompressed graphics is written to a graphics plane,

by referring to a value of a presentation time stamp of the

window define packet.

25   22. The reproduction apparatus of Claim 21, wherein

the graphics stream includes a palette define packet

storing palette information that defines color setting used

in display of the graphics data,

the reproduction apparatus includes a color conversion

5   unit operable to perform color conversion on graphics stored

in the graphics plane, and

the controller, when the current reproduction point

reaches a point shown by a presentation time stamp of the

palette define packet, sets the palette information in the

10   color conversion unit.

23. The reproduction apparatus of Claim 19, wherein

the graphics stream has two sets of graphics data,

a value of a presentation time stamp of the control packet

15   is obtained by adding a predetermined value to a value of

a presentation time stamp of the data packet, where the

predetermined value is a total of a period x and a period

y,

the period x being a longer one of: a total of

20   a period required for clearing a screen and a period

required for writing the former of the two sets of graphics

data after decoded, to the screen; and a total period

required for decoding the two sets of graphics data, and

the period y being a period required for writing,

25   to a screen, the latter of the two sets of graphics data

after decoded, and

the controller, when the current reproduction point reaches a point shown by a presentation time stamp of the control packet, displays content of the graphics plane.

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24. The reproduction apparatus of Claim 15, wherein the graphics stream includes a plurality of data packets storing graphics data, including the data packet,

the data packets make up a data-packet sequence,

10   the data-packet sequence constitutes graphical button materials,

the graphics decoder combines, with a moving picture, an interactive screen that includes the graphical button materials, and displays the interactive screen combined with

15   the moving picture, and

the reproduction apparatus performs, when the reproduction point of the video stream reaches a point shown by a time stamp of the control packet, an initial display of the interactive screen by using graphics data positioned

20   up to a middle of the data-packet sequence, and

the reproduction apparatus performs, when a user operation is received, updating of the interactive screen by using graphics data positioned after the middle of the data-packet sequence.

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25. The reproduction apparatus of Claim 24, wherein

a time at which the initial display of the interactive

screen is performed is obtained by adding a predetermined

period to a decoding ending time of graphics data positioned

5   at the middle of the first-packet sequence,

where the predetermined period is based on a total of

a first period required for clearing a graphics plane of the

reproduction apparatus and a second period required to perform

writing for the initial display, to the graphics plane.

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26. The reproduction apparatus of Claim 25, wherein

if type information included in the control information

indicates a memory management start, the controller sets,

as the predetermined period, a total of the first period and

15   the second period,

and if the type information indicates either a difference

with preceding control information, or a duplicate of the

preceding control information, the controller sets the second

period as the predetermined period.

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27. The reproduction apparatus of Claim 24, wherein

if button materials, which are to be in a selected state

as a default in the initial display, are statically determined,

the control information includes default selected

25   information specifying the button materials, and calculates

the second period, based on a total of firstly displayed part

of decompressed graphics data representing a selected state

of one button and firstly displayed part of decompressed

graphics data representing normal states of buttons different

5   from the button.

28. The reproduction apparatus of Claim 24, wherein

if button materials, which are to be in a selected state

as a default in the initial display, dynamically change,

10   the second period is a period required for writing data

of size T, to the graphics plane,

where the size T is obtained by adding together sizes

x of all buttons, a size x being obtained by an expression

of:

15   size x = max(N-first, S-first),

N-first representing firstly displayed part of

entire graphics data representing a normal state,

S-first representing firstly displayed part of

entire graphics data representing a selected state, and

20   max(a,b) being a formula for indicating one of

"a" and "b" that has a larger size therebetween.

29. A recording method for a recording medium, the

recording method comprising:

25   a step of creating application data; and

a step of recording the created application data to the

recording medium, wherein

the application data includes a digital stream that is

obtained by multiplexing a graphics stream and a video stream,

5   the graphics stream being a packet sequence that includes

a data packet storing graphics data and a control packet storing

control information,

the data packet has a time stamp whose value indicates

a decoding time of the graphics data, and

10   the control packet has a time stamp whose value indicates

a time at which the graphics data, after being decoded, is

displayed combined with the video stream.

30. An integrated circuit used in a reproduction

15   apparatus for a digital stream, the digital stream being

obtained by multiplexing a video stream and a graphics stream,

the graphics stream being a packet sequence that includes

a data packet storing graphics data and a control packet storing

control information, the integrated circuit comprising:

20   a video decoder operable to obtain a moving picture by

decoding the video stream; and

a graphics decoder including:

a processor that starts decoding of graphics data when

a current reproduction point of the video stream reaches

25   a point shown by a decode time stamp of the data packet,

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and ends the decoding when the current reproduction point reaches a point shown by a presentation time stamp of the data packet; and

a controller that, according to a presentation time stamp of the control packet, displays the graphics data, after being decoded, combined with the video stream.

31. A program that makes a computer perform reproduction of a digital stream, the digital stream being obtained by multiplexing a video stream and a graphics stream, the graphics stream being a packet sequence that includes a data packet storing graphics data and a control packet storing control information, the program comprising:

a code that makes the computer obtain a moving picture by decoding the video stream; and

a code that makes the computer perform graphics rendering by which the graphics data combined with the moving picture is displayed, the graphics rendering performed by the computer including:

a process of starting decoding of graphics data when a current reproduction point of the video stream reaches a point shown by a decode time stamp of the data packet, and ending the decoding when the current reproduction point reaches a point shown by a presentation time stamp of the data packet; and

a process of, according to a presentation time stamp
of the control packet, displays the graphics data, after
being decoded, combined with the video stream.

5   32. A reproduction method for a digital stream that is
obtained by multiplexing a video stream and a graphics stream,
the reproduction method comprising:

a process of obtaining a moving picture by decoding the
video stream; and

10   a process of performing graphics rendering by which the
graphics data combined with the moving picture is displayed,
the graphics rendering including:

a process of starting decoding of graphics data when
a current reproduction point of the video stream reaches

15   a point shown by a decode time stamp of the data packet,
and ending the decoding when the current reproduction point
reaches a point shown by a presentation time stamp of the
data packet; and

a process of, according to a presentation time stamp

20   of the control packet, displays the graphics data, after
being decoded, combined with the video stream.